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FLOOD INSURANCE STUDY

COMPLETED

ORIGINAL

CITY OF CLAREMORE, OKLAHOMA
ROGERS COUNTY

SEPTEMBER 18, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 405375

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
CITY OF CLAREMORE, OKLAHOMA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Claremore, Rogers County, Oklahoma, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will allow Claremore to continue participation in the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

This Flood Insurance Study was prepared by compiling pertinent information for the flood hazard areas in the City of Claremore from existing technical and/or scientific data originally prepared by others for purposes other than the preparation of this Flood Insurance Study. This existing data was reviewed by FEMA prior to its use in the development of this Flood Insurance Study to ensure compliance with National Flood Insurance Program (NFIP) accuracy requirements.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study represent a revision of the original analyses. The updated version was prepared by the Tulsa District of the U. S. Army Corps of Engineers during the preparation of the Flood Insurance Study for the unincorporated areas of Rogers County. The Rogers County study was completed in March 1984.

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1.3 Coordination

On August 21, 1985, the results of this study were reviewed at a final Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA and the City of Claremore.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Claremore, Rogers County, Oklahoma. A small unincorporated area of Rogers County was not included in this study. The area of study is shown on the Vicinity Map (Figure 1).

Dog Creek was restudied by detailed methods for its entire length affecting the community. Cat Creek was restudied by detailed methods for its entire length within the corporate limits. The areas studied by detailed methods were selected based upon the extent and validity of available existing hydrologic and hydraulic data.

Lake Claremore and several unnamed streams were studied by approximate methods. Approximate methods of analysis were used to study all remaining areas having a potential flood hazard that did not have available scientific or technical data.

2.2 Community Description

The City of Claremore is located in the central portion of Rogers County in northeastern Oklahoma. Rogers County is immediately northeast of the City of Tulsa. Claremore, the county seat, is completely surrounded by unincorporated areas of Rogers County.

Trees and brush generally grow in and adjacent to the stream channels in the study area. Vegetation includes native prairie grasses (big and little bluestem, switch grass, and side oats grama) and introduced species such as Bermuda grass and Fescue. Trees in the study area include Juniper, Cedar, Spruce, Elm, Blackjack, and varieties of Oak. Outcrops consist of limestone, shales, and sandstones. Soils vary from residual materials in the upland areas to alluvial types in the flood plains and river terraces.

The climate of Claremore is continental, characterized by a wide range of temperatures. Daily temperatures range from an average of 82 degrees Fahrenheit (°F) in July to an average of 37°F in January. The mean

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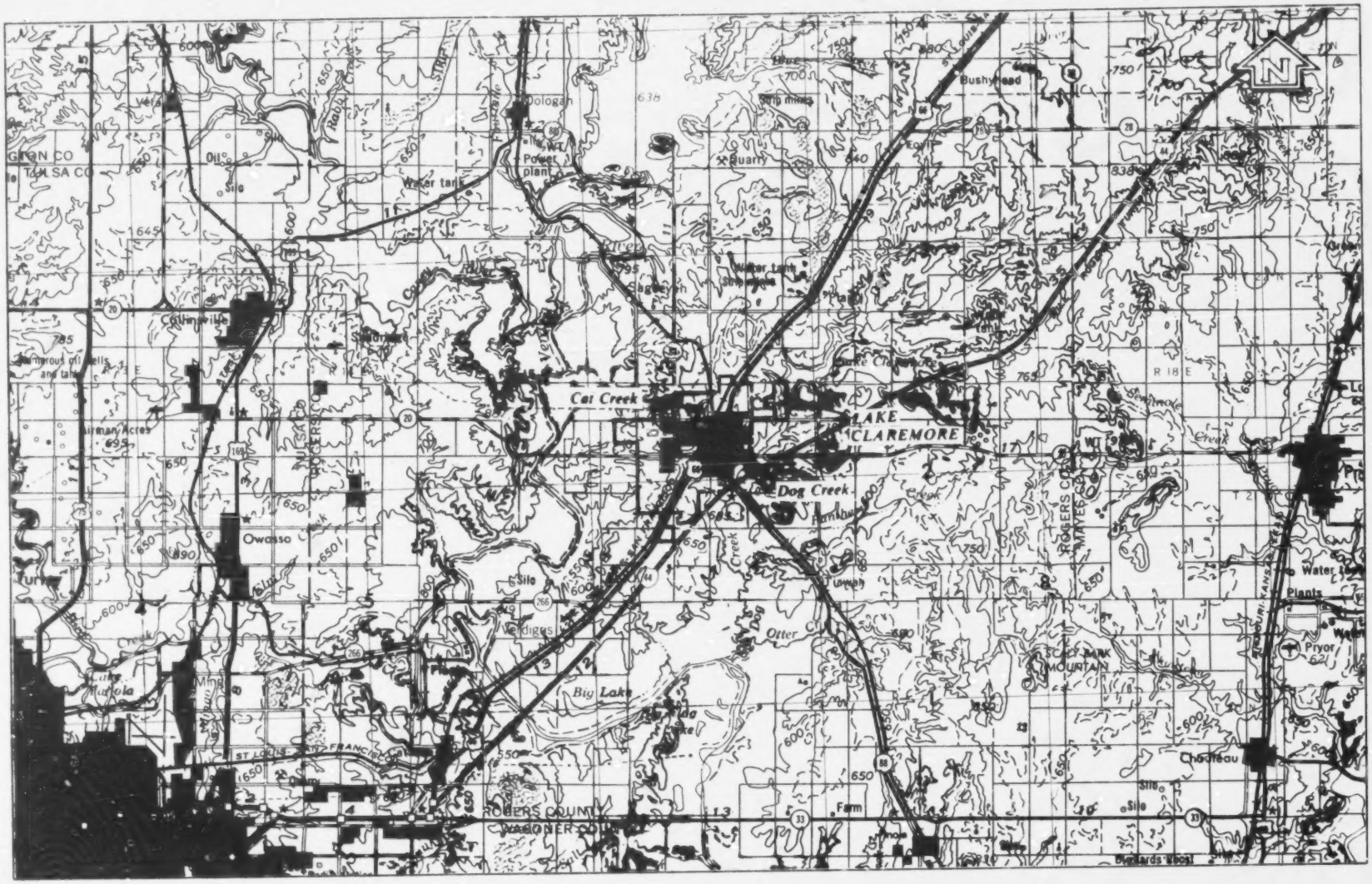

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CLAREMORE, OK

(ROGERS CO.)

VICINITY MAP

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annual temperature is 60°F. The average annual precipitation is 38 inches, including an average snowfall of approximately 9 inches. Most of the precipitation occurs during the six-month period from April through September. Summer rains are generally the result of thunderstorms which are usually of short duration, high intensity, and limited coverage.

2.3 Principal Flood Problems

There is no historic flood information available for Dog Creek. The only known record of flooding is on Cat Creek, which was determined by several high- water marks taken during the June 8, 1974, flood. The high-water marks are located just upstream of Will Rogers Boulevard in Claremore, where water reached an elevation of 598 feet. The flood, which was approxi- mately a 25-year event, caused considerable property damage.

2.4 Flood Protection Measures

The Cat Creek channel has been straightened and cleared in several places; however, the channel will not carry the 100-year flood. This study reflects the channel modifications. There are no other known structural flood control measures that affect the study area.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

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3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Discharges for Dog Creek and Cat Creek were obtained from the Flood Insurance Study for Rogers County (Reference 1). In that study, flood-flow frequency data were based on a synthetic unit hydrograph approach and a regional frequency analysis. The watershed was appropriately subdivided, and synthetic unit hydrographs were determined for each sub-area, using Snyder's Method. Snyder's unit graph coefficients were based on data contained in the Verdigris River Hydropower Feasibility Study (Reference 2). Rainfall data were obtained from Technical Paper No. 40 and adjusted based on regional studies conducted for the Flood Insurance Study for Tulsa County (References 3 and 4). The estimated rainfall excesses were then applied to the unit graphs to obtain runoff. Runoff from the individual sub-areas was then routed downstream by the storage discharge method and combined to determine peak flow values at selected points along the streams. This was done using the U. S. Army Corps of Engineers (COE) HEC-1 computer program (Reference 5).

A summary of drainage area-peak discharge relationships for Dog Creek and Cat Creek is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
DOG CREEK					
Downstream of the confluence of Cat Creek	65	7,540	19,600	27,000	54,000
At State Route 20	61.5	6,990	18,130	24,820	47,480
At Blue Starr Drive	60	7,030	18,300	24,950	46,950
CAT CREEK					
At Interstate 44	9.6	2,930	6,050	7,770	14,000
At U. S. Route 66	6.4	2,050	4,270	5,360	9,000
At Blue Starr Drive	4.6	1,700	3,450	4,320	7,250
At Jay Street	3.2	1,180	2,520	3,180	5,500

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

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Cross sections for the backwater analyses of Dog Creek were obtained by field surveys. Cross sections for Cat Creek were taken from topographic maps (Reference 6). When available, bridge and road plans were used to obtain elevation data and structural geometry. Other bridges were field measured.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 7). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for Dog Creek were determined by the slope/area method. Starting water-surface elevations for Cat Creek were determined assuming coincident peak flows at its confluence with Dog Creek.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment based on field observations of the streams and flood plain areas. The channel "n" value for Dog Creek was 0.055, and the overbank "n" value was 0.050. The channel "n" values for Cat Creek ranged from 0.040 to 0.090, and the overbank "n" values ranged from 0.040 to 0.115.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual

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chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (References 6 and 8).

For the areas studied by approximate methods, the boundary of the 100-year flood was delineated using the previous Flood Insurance Study for Claremore (Reference 9).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths for Dog Creek extend beyond the corporate limits.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Dog Creek								
A	18,560[1]	300/170[3]	3,765	6.6	594.5	594.5	594.8	0.3
B	19,160[1]	395	4,303	5.8	595.1	595.1	596.0	0.9
Cat Creek								
A	3,670[2]	296	2,369	3.3	582.7	582.7	582.8	0.1
B	4,190[2]	159	1,770	4.4	583.4	583.4	584.0	0.6
C	6,150[2]	517	4,568	1.7	584.5	584.5	585.3	0.8
D	7,210[2]	356	3,916	1.9	584.8	584.8	585.6	0.8
E	8,050[2]	328	3,108	2.4	585.0	585.0	585.8	0.8
F	8,930[2]	465	3,631	2.0	585.3	585.3	586.1	0.8
G	9,800[2]	622	4,530	1.6	585.8	585.8	586.7	0.9
H	11,580[2]	635	3,701	2.0	586.3	586.3	587.1	0.8
I	12,320[2]	624	3,377	2.2	586.6	586.6	587.4	0.8
J	15,930[2]	80	934	4.7	599.3	599.3	599.7	0.4
K	16,090[2]	125	1,043	4.2	599.6	599.6	600.2	0.6
L	17,680[2]	231	1,626	2.7	600.0	600.0	600.8	0.8
M	18,910[2]	100	610	7.1	601.0	601.0	601.9	0.9
N	19,100[2]	500	2,760	1.6	602.7	602.7	603.7	1.0
O	20,440[2]	360	1,805	2.4	603.8	603.8	604.7	0.9
P	21,460[2]	327	1,577	2.7	605.0	605.0	605.9	0.9
Q	22,380[2]	310	1,825	2.4	605.9	605.9	606.8	0.9
R	23,310[2]	131	768	5.6	607.8	607.8	608.6	0.8

[1]Feet above confluence of Cat Creek
[2]Feet above confluence with Dog Creek
[3]Width/width within corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
CITY OF CLAREMORE, OK
(ROGERS CO.)

FLOODWAY DATA

DOG CREEK - CAT CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Cat Creek (continued)								
S	24,200	337	1,145	2.8	611.4	611.4	612.0	0.6
T	26,930	472[2]	1,361	2.3	617.0	617.0	617.4	0.4

[1]Feet above confluence with Dog Creek
[2]Width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
CITY OF CLAREMORE, OK
(ROGERS CO.)

FLOODWAY DATA

CAT CREEK

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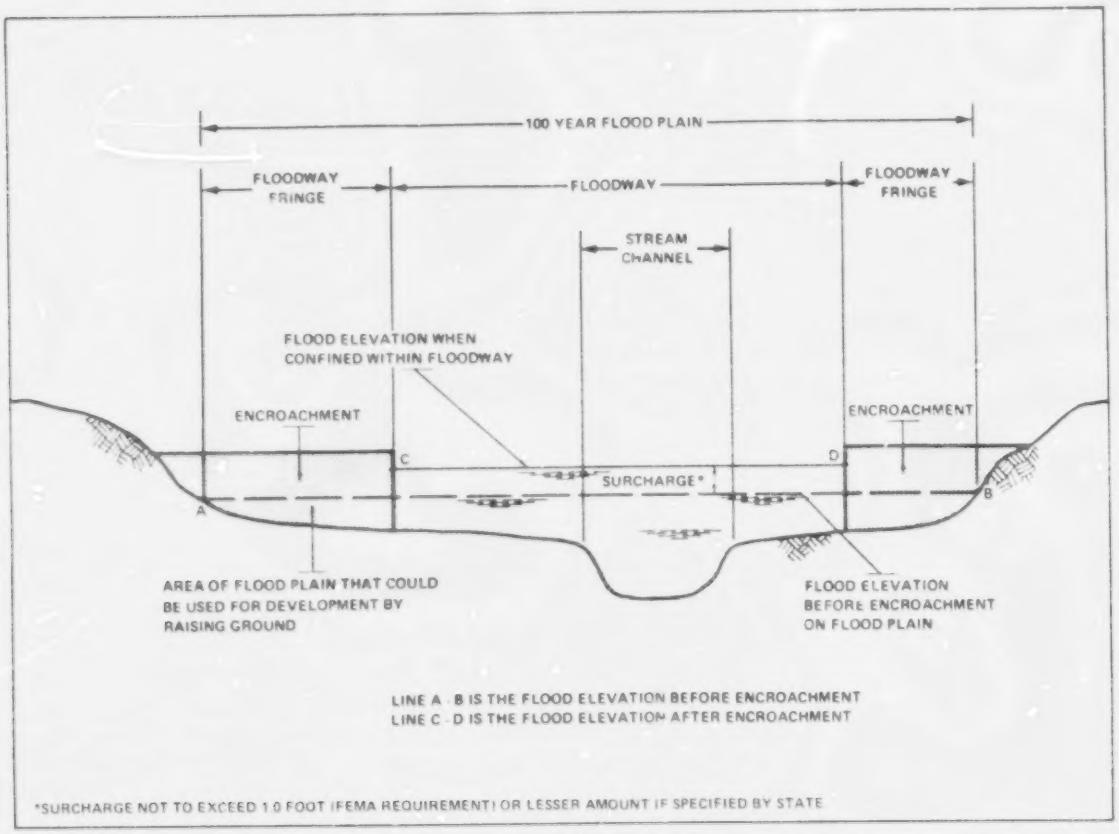
The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the City of Claremore.

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5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the City of Claremore are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Dog Creek							
Reach 1	05	-5.8	-2.3	+5.8	060	A12	Varies
Cat Creek							
Reach 1	05	-4.3	-1.2	+4.7	045	A9	Varies
Reach 2	05	-2.8	-0.9	+3.2	030	A6	Varies
Reach 3	05	-3.8	-0.6	+1.4	040	A8	Varies
Reach 4	05	-1.9	-0.5	+1.2	020	A4	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CLAREMORE, OK

(ROGERS CO.)

FLOOD INSURANCE ZONE DATA

DOG CREEK – CAT CREEK

Zones A4, A6, A8, A9, and A12: Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Claremore is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared by the SCS and other organizations originally for purposes other than the preparation of this Flood Insurance Study. The data was identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. FEMA performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the NFIP. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, Federal Emergency Management Agency (Regional Director, Region VI Office, Federal Center, Denton, Texas 76201) for consideration for revision of this study.

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The Flood Insurance Study for the unincorporated areas of Rogers County is currently being prepared (Reference 1). The results of that study will be in exact agreement with the results of this study.

A Flood Insurance Study has previously been published for the City of Claremore (Reference 9). The differences between the previous study and this study are justified due to the more detailed nature of this Flood Insurance Study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region VI Office, Federal Center, Denton, Texas 76201.

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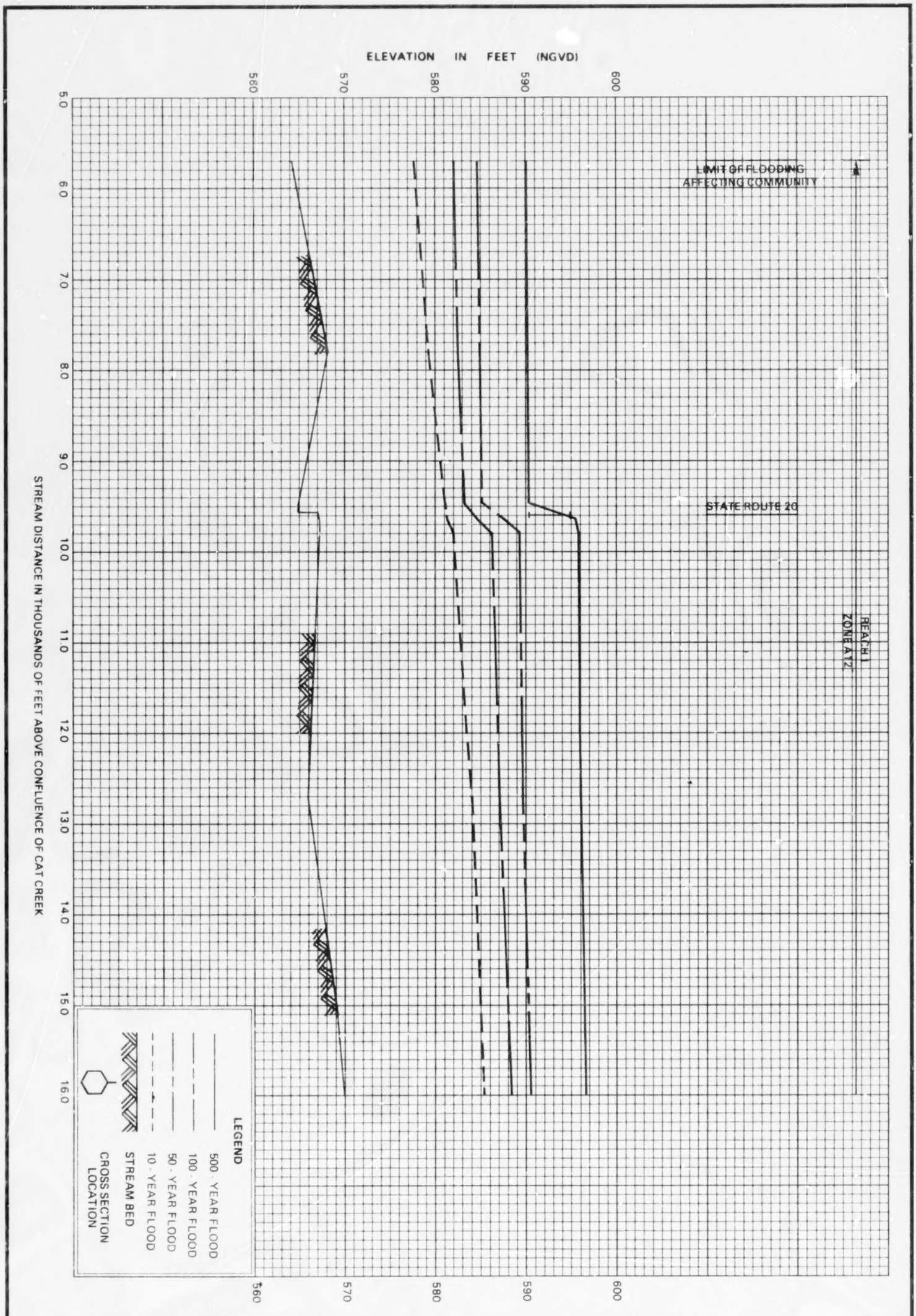

01P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF CLAREMORE, OK (ROGERS CO.)	FLOOD PROFILES DOG CREEK

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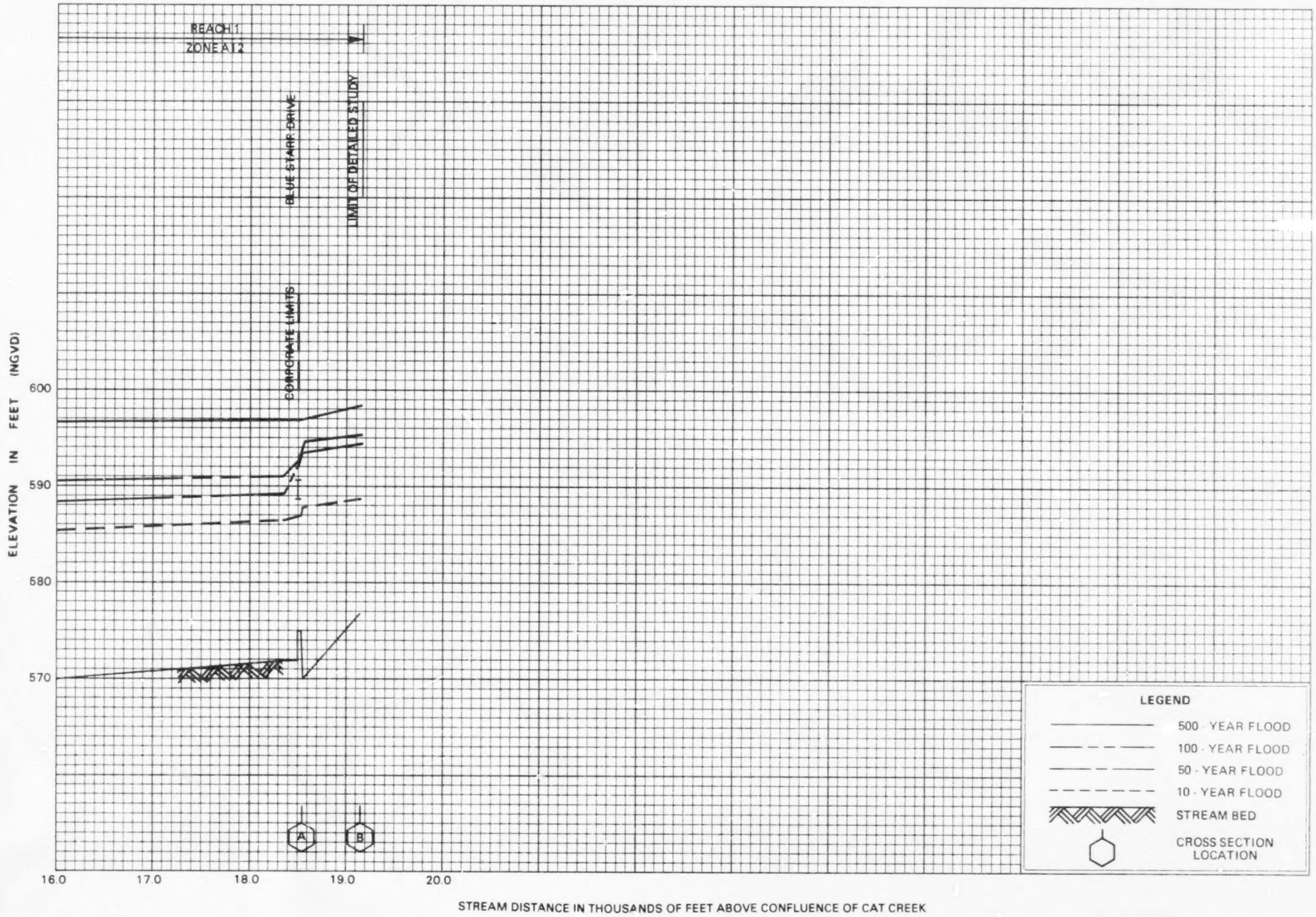

FLOOD PROFILES

DOG CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CLAREMORE, OK

(ROGERS CO.)

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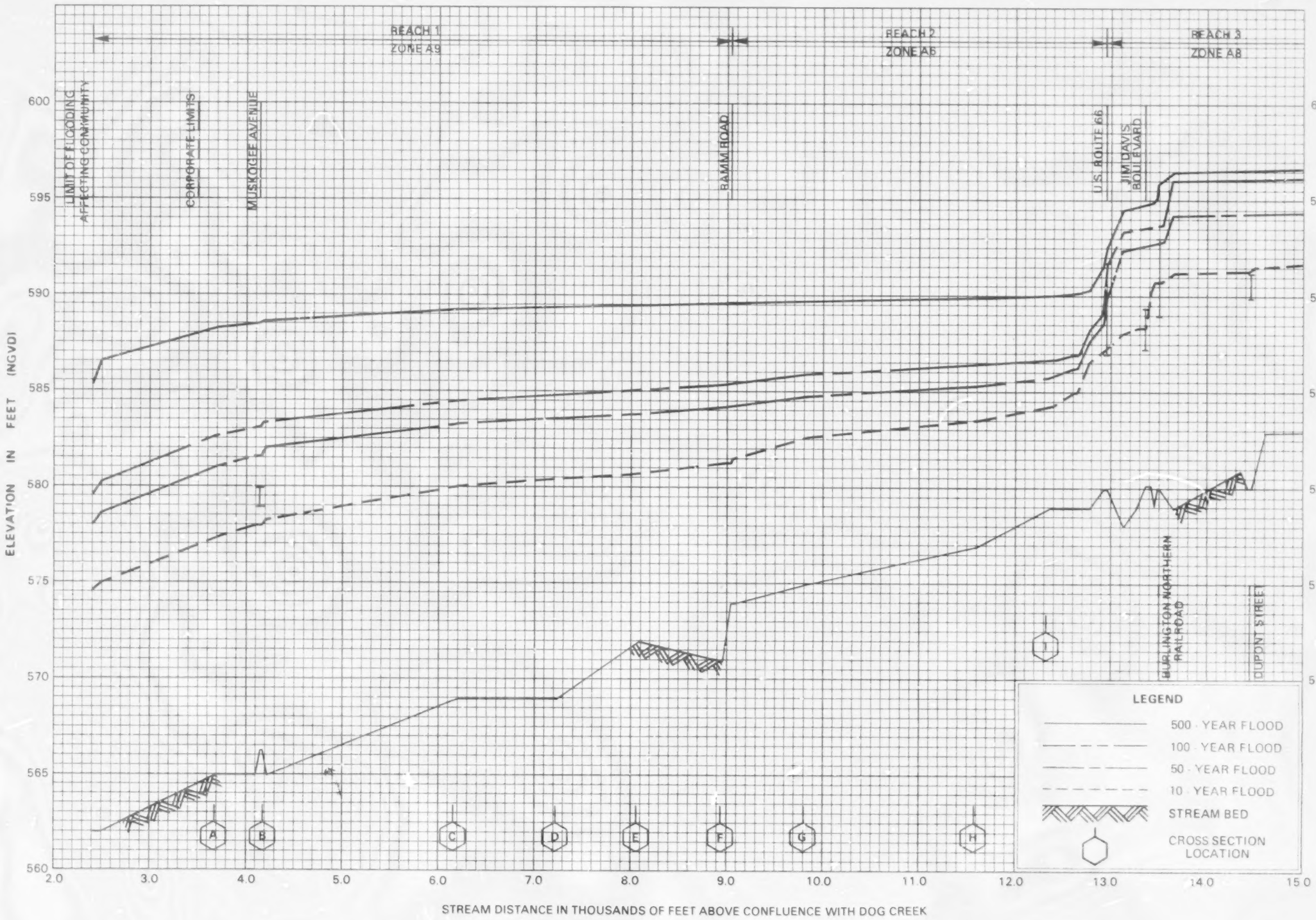

FLOOD PROFILES

CAT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CLAREMORE, OK

(ROGERS CO.)

03P

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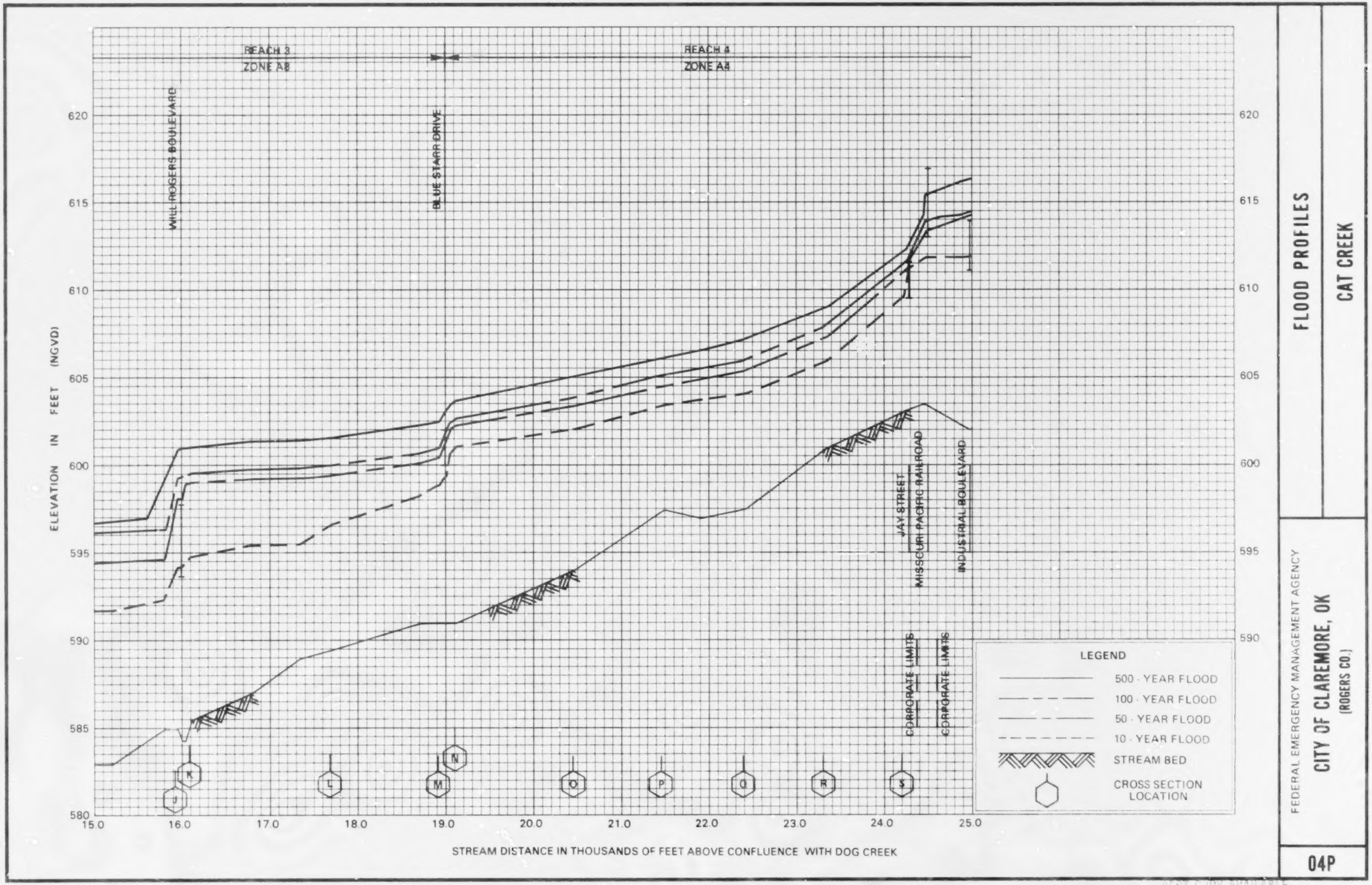

FLOOD PROFILES

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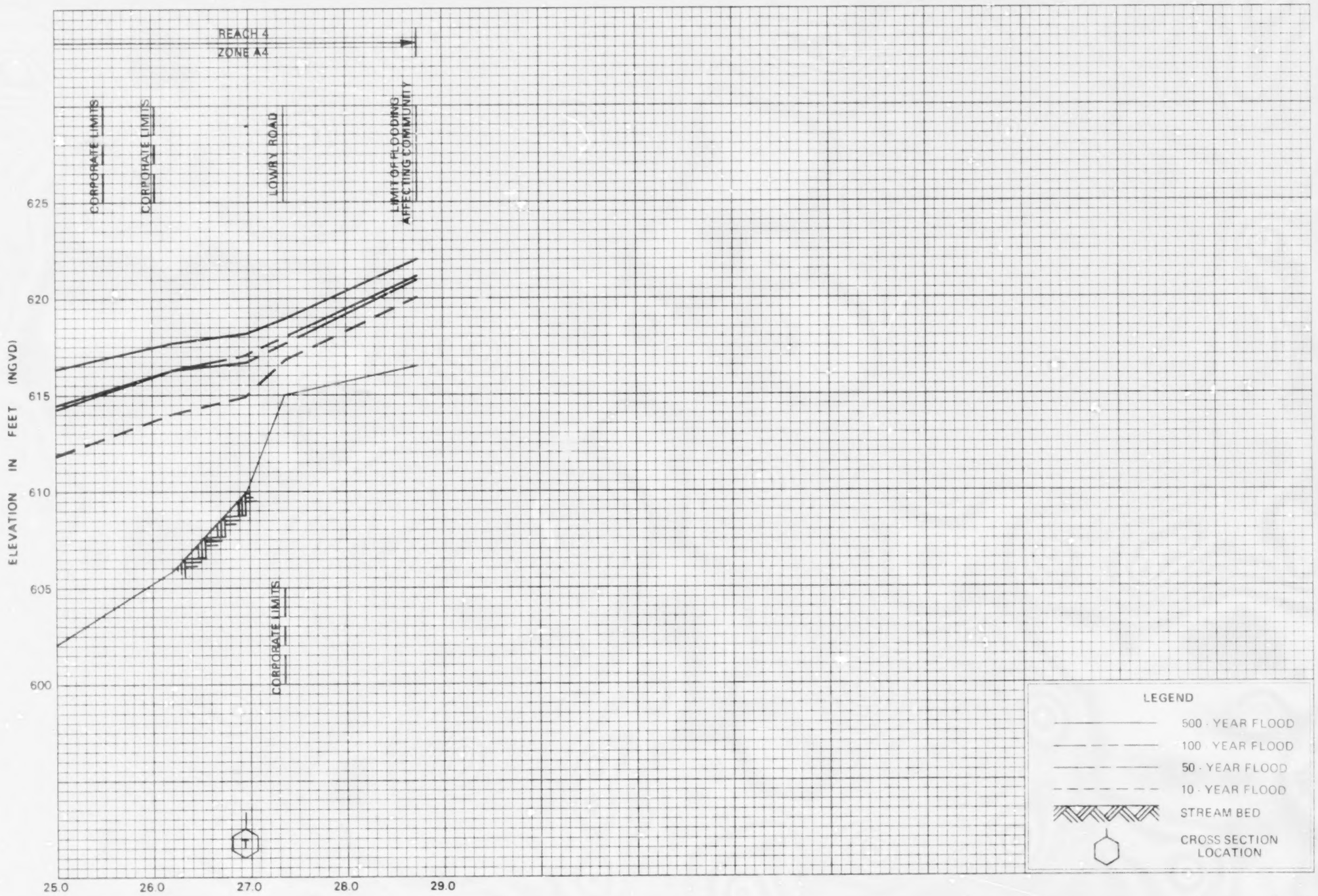

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